



ICAR - NRCB NEWSLETTER

ICAR - National Research Centre for Banana

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ICAR - NRCB welcomes Dr. A. K. Singh, New Deputy Director General (Hort. Sci.), ICAR

Dr. Anand Kumar Singh completed his M. Sc. & Ph.D. from ICAR-IARI, New Delhi and post doctoral research from Japan and USA. He served as Senior Scientist at ICAR-IIVR, Varanasi, as Principal Scientist and Head, Division of Fruits & Horticultural Technology, IARI, New Delhi. In his illustrious career, he has worked in various capacities as Managing Director, National Horticulture Board; Chairman, Coconut Development Board and Executive Director, National Oilseeds and Vegetable Oils Development Board (NOVOD), Ministry of Agriculture and farmer's Welfare, Government of India. His major research contributions include genetic improvement, plant tissue culture and transcriptome studies of fruit crops. He has published 112 research papers in peer reviewed journals and recipient of awards like Mombusho Award by the Japanese Government; Award of the Ministry of Human Resources, Government of India; Visiting Scientist Award from the Association of International Education, Japan and the DBT Overseas Associateship Award. He was been recognized as Fellow of National Academy of Agricultural Sciences; National Academy of Biological Sciences and Horticultural Society of India. The Director and Staff of ICAR NRCB greet Dr. A. K. Singh the very best in his present assignment and look forward to receive his support, valuable guidance and leadership in all the activities of the Institute.



From Director's Desk

ICAR-NRCB, Tiruchirapalli has four major research fronts in focus. This issue's focus is on "Improvement of banana through conventional breeding". Banana breeding is an art where seed development is essential to develop hybrids and sterile fruits (Parthenocarpic) are essential consumption. Thus banana is one of

the recalcitrant crops for improvement through breeding. ICAR-NRCB has made a breakthrough in this area of research and the work done in the last decade is briefed.

Two major issues important for banana industry are report of occurrence of Fusarium Wilt Tropical Race 4 in India, first noticed in Katihar and Purnia districts of Bihar state not only on Grand Naine, but also on few other commercial varieties. ICAR along with Central Plant Quarantine Department, State Departments, State Agricultural Universities and other local bodies have taken stringent measures to keep check on its spread with strong sensitization programmes. The other issue is Rugose spiralling whitefly, becoming a serious pest on banana in Tamil Nadu. Natural enemies, parasitoids and predators of this white fly are recorded.



During this period, we conducted two trainers' training programme "High Tech banana cultivation for enhancing production and productivity of banana". Programmes to banana growers of North Eastern states of India were given impetus and five empowerment trainings were offered.

ICAR-NRCB has signed a MoU for the "Development of sea protocol for the shipment of export on traditional bananas" with APEDA and Fair Exports Pvt. Ltd, Kochi. The Centre also signed a MoA for the collaborative project with IITA, Uganda and six other countries through Bioversity International, France and New Delhi.

I hope with good collaborations, the important issues of Fusarium wilt TR4 and Rugose spiralling whitefly are kept at bay for the benefit of banana industry and ICAR-NRCB urges all stakeholders to cooperate.

S. Uma
(S. UMA)

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INFOCUS

IMPROVEMENT OF BANANA THROUGH CONVENTIONAL BREEDING

Asexual means of propagation through suckers is the major factor limiting the occurrence of variability in banana. This added to the sterile, parthenocarpic and polyploid nature of banana makes its improvement through conventional breeding a difficult task. Limited variability and inability to develop new varieties has ultimately increased the incidence of pest and diseases threatening banana cultivation. So to tackle such pest and disease problems, banana improvement programmes inclusive of exotic introduction and their evaluation under Indian conditions, clonal selections, hybridization etc. are very much essential and they are well prioritized in the mandates of ICAR - NRCB.

Introduction

Exotic introduction and their multi-locational evaluation have led to the release of two varieties namely Saba and Bangrier and another variety Namwa Khom is under multi-locational evaluation.

Clonal selection

Being a vegetatively propagated crop, clonal selection is yet another important strategy in banana improvement program. The field evaluation of Manoranjitham tissue culture plantlets, resulted in identification of a high yielding somaclonal variant whose bunch weight is 51 kgs (> 300% increased yield over local check) with 12 - 14 hands and 17 - 20 fingers per hand. The yield

was almost stable even during the third ratoon (46 kgs). To evaluate the yield stability of the high yielding variant selected from Kolli hills, they were mass multiplied and being evaluated at three different locations in Tamil Nadu at different altitudes.

Sexual hybridization

Although banana is parthenocarpic in nature, interestingly, some banana cultivars have a very low residual fertility, and few seeds may be obtained by crossing hundreds or thousands of fertile diploids with sterile triploids. This residual fertility is being exploited for improving banana through sexual hybridization to transfer the desirable traits into commercial cultivars.

Tetraploid breeding scheme

The initial steps for improvement of plantains or bananas traditionally involved crossing a commercial triploid to be improved with diploid that is disease-resistant to produce tetraploid hybrids. The tetraploid hybrids so obtained are both female and male fertile that often reduces fruit quality due to the presence of seeds in the pulp. This is overcome by crossing the 4x hybrids with diploids to produce secondary triploids (3x) of commercial importance.

Development of synthetic tetraploid

A total of five tetraploids of Pisang Awak group have been developed by crossing triploid Pisang Awak group with diploid male parent. All the tetraploids were tall with drooping nature having thick lamina and parthenocarpic with residual female fertility. These progenies are being used as female parents in banana improvement programs.

Cultivar	Bunch Weight (Kg)	Duration (days)	Special attributes
Saba (ABB - Bontha)	26 - 29	360 - 380	Suitable for marginal and saline sodic soils with pH ranging from 8.8 to 9.0 and more tolerant to drought. It is a dual purpose variety that could be used both for culinary and dessert purposes.
Bangrier (ABB - Bluggoe)	28 - 30	360 - 390	Tolerant to Fusarium wilt (Foc race 2). Pulp has a mealy texture with good cooking quality.
Namwa Khom (ABB - Pisang Awak)	25	365	Dwarf statured, short duration cultivar with high sugar content (29° Brix). Suitable for high density planting without propping and annual cropping system.

Improved diploid	Special attributes
Progeny No. 429 (Cv. Rose x Pisang Lilin)	An improved AA diploid which is resistant to Fusarium wilt (Foc race 1) field tolerant to Sigatoka, high pollen fertility, parthenocarpic, appreciable fruit size with 14-15cm length, and 25-26° Brix. Hence, this diploid is being used both as male and female parents for the development of superior hybrids.
Progeny No. 134 (Anaikomban x Matti)	Field tolerant to Sigatoka leaf spot diseases. Pollens showed 99.5% viability. There are 5-6 hands in a bunch with long and parthenocarpic fruits.
Progeny No. 148 (Pisang Jajee x Lairawk)	Promising diploid produces 12-14 hands with 20-24 fruits per hand and found 5-10 seeds in few fruits. It is found to be resistant to Sigatoka diseases (<i>Mycosphaerella eumusae</i>) and highly polleniferous in nature. Hence this valuable progeny may be utilized both as female and male parents in banana improvement programmes.
Progeny No. 97 (Matti)	Field tolerant to Sigatoka disease. (<i>M. eumusae</i>) This produced parthenocarpic fruits with (Pisang Jajee x the bunch weight varying from 5-6 kgs. Fruits are short with 9-10cm length, tapering towards the distal end with persistent style. Owing to its biotic stress resistance, female fertility and parthenocarpic nature of diploid, these progenies are being used in banana breeding programs.
Progeny No. 207 (Matti x Cv. Rose)	Diploid progeny with high male and female fertility. Field tolerant to Sigatoka (<i>M. eumusae</i>) leaf spot diseases.

Development of open pollinated progenies of natural tetraploid banana

Evaluation of 32 progenies obtained from open pollinated seeds of natural tetraploid, Bhat Manohar resulted in identification of one promising progeny (progeny No. 667) that performed better in terms of yield and other quantitative traits. This recorded a bunch weight of 19.5 kg which is 90% higher than the original Bhat Manohar (10.5 kg). Fruit length (14.5 cm) was 50% more than the normal (9.5cm). This could either be used directly in commercial cultivation or be used in the development of superior triploids.

Diploid breeding scheme

Use of improved diploids in the development of new commercial hybrids is one of the important strategies commonly used in most banana improvement programs. Hence, efforts were taken to develop improved diploid which are polleniferous and with good agronomic traits such as disease resistance, high fruit yield etc. The special attributes of the five improved diploids developed by ICAR - NRCB are given in the table.

Improvement of banana through hybridization

To improve the existing commercial varieties in terms of yield and other quality parameters like resistance to biotic stresses namely Fusarium wilt, Sigatoka leaf spot and nematodes; flavor and taste, hybridization was attempted in commercial cultivars using diploid male parents.

Improvement of plantain types

In plantain subgroup, a total of 47 Nendran based progenies, were evaluated for two years. Morphological and molecular characterization of Nendran based hybrids indicated that variation existed both between the cross combinations and within the same combination. It was further observed that NCR12/18 recorded 17.5 kg bunch weight whereas NPL12/33 recorded 16.5 kg which is 30-40% higher than Nendran. Interestingly, more carotenoid content was recorded NCR 12/33 (2592.12µg/g of dry weight) than Nendran (1160.09µg/g of dry weight).

Improvement of cooking type bananas

A preliminary evaluation trial has been conducted with 16 hybrids of Saba x Pisang Lilin cross combination and found that three progenies namely progeny No 684, 685 and 690 recorded an average bunch weight of 22, 42 and 32 kgs respectively over a period of three years. Bunch and fruit characteristics of Progeny No.684 were like Saba (dark green fruits, blunt tip) while progeny No. 685 had green and pointed tip as in Kothia (ABB). Fruit hands of progeny No.690 are loosely packed, matured fruits are green and slightly wax coated. The preliminary sensory analyses suggested that these hybrids are more suitable for culinary purpose.

Developing hybrid for leaf industry

Progeny No. 14 of the cross combination Anaikomban (AA) x Pisang Jajee (AA) was found suitable for leaf industry as it had better quality leaves compared to Poovan (AAB) and Karpuravalli (ABB), which are the varieties commonly cultivated for leaf production. This hybrid possess longer leaf length (250 - 270 cm), width (80-95 cm), soft midrib, thin leaf blade with high flexibility and free from leaf spot diseases. It has better keeping quality (one week) at room temperature than normal cultivars. The leaf production is also increased upto 12 leaves per plant.

Development of ornamental hybrids

Hybridization programme has also been initiated to develop ornamental novel types with short stature, attractive bracts, and

wider adaptability using *Musa laterita*, *M. ornata*, and *M. siamensis*.

Improvement of bananas for Sigatoka leaf spot (*Mycosphaerella eumusae*) resistance

To develop resistant varieties for Sigatoka leaf spot diseases, hybridization was effected between Poovan x Pisang Lilin, Poovan x Calcutta 4, Grand Naine x Pisang Lilin and Grand Naine x Calcutta 4.



Bangrier

Saba

Namwa Khom

RESEARCH HIGHLIGHTS

Crop Improvement

- ◆ Evaluation of eight putative wilt resistant mutants of cv. Rasthali under pot conditions indicated that only NRCB RM 217 sustained resistance.
- ◆ Floral characters of *Musa laterita*, *M. siamensis* and *M. ornata* were characterized. *M. ornata* recorded highest pollen output / anther (58988.1), viability (94.82%) and germination (84.48%).
- ◆ Reproductive studies revealed that species of *Rhodochlamys* are highly cross compatible (17 - 27 seeds/finger).

Crop Production

- ◆ Clump management experiment in cv. Ney Poovan showed that application of 125% recommended dose of fertilizer (RDF) recorded early flowering (320.3 days) compared to 175% RDF (335.9 days).
- ◆ Pre-harvest application of 1-methylcyclopropne (1µl/L) for 12 hrs on full mature Poovan bananas enhanced in plant green life for 10 days and treatment of full mature Poovan bananas with lyso-phosphatidyl-ethanolamine (500 ppm) enhanced in *planta* green life only for 4 days.
- ◆ Soil moisture deficit stress imposed banana cv. Grand naine applied with stress alleviation chemicals of Acetyl Salicylic Acid (ASA), Butylated Hydroxy Toluene (BHT) and Glycine Betaine (GB) recorded an average of 35.25kg bunch weight with 12.75 hands compared to 19.75kg with 9.25 hands in control.

Post Harvest Technology

- ◆ Under active packaging, fruits of banana cv. Udhayam harvested at 85% maturity and stored at 13.5 °C extended the shelf-life of upto 102 days compared to control at room temperature (29 days).
- ◆ Estimated post-harvest losses in banana cv. Grand Naine was 15.70 % and 15.04%, in Theni and Erode districts of Tamil Nadu respectively, while in cv. Poovan, it was 25.32% and 13.73% in Trichy and Tuticorin districts respectively.

- ◆ Pre-treatment of fruits of banana cv. Grand Naine with Potassium meta bisulphite and Citric acid (0.25% each) for drying resulted better acceptability of flour (8.6) than NaCl (1%) treatment. (7.3).
- ◆ Better rehydration ratio (1:2.4) and resistant starch content (49.26%) was observed with the drying temperature of 55°C than other temperatures.
- ◆ Equilibrium relative humidity (RH) studies revealed that 13.13 % and 14.57% were the danger and critical point respectively for storing the banana flour.
- ◆ Optimum RH for storing the banana flour was worked out as 55 - 60%.
- ◆ Silver nano particles of botanical Zimmu and bioagent *Trichoderma asperellum* culture filtrate completely inhibited (100%) the mycelial growth and spore germination of Fusarium wilt under *in vitro* as well as pot conditions.
- ◆ Field evaluation of ECS derived BBTV free Hill banana plants conducted at NRCB Research farm showed significant difference in the growth and yield parameters compared to sucker grown plants, however the yield and growth parameters of these plants were on-par with tissue culture raised plants. An increase of 23.5 % bunch weight over sucker grown plants was recorded from ECS derived hill banana plants. None of the BBTV free plants showed any symptoms.
- ◆ Severe infestation of root-knot nematode was observed in soil and root samples collected from wilt sick fields of banana cv. Grand Naine in Gudalur, Cumbam areas of Theni District, Tamil Nadu.

Crop Protection

- ◆ Seventy percent mortality of stem weevil was observed when Zimmu extract was applied under *in vitro* conditions.
- ◆ Severe infestation of Rugose spiralling whitefly, *Aleurodicus rugioperculatus* was documented on banana in Pollachi and nearby places in Tamil Nadu.

OTHER INFORMATION

Events	Date	Details
IRC meeting	18 - 20 January, 2017	21 st Institute Research Council meeting of ICAR - NRCB
RAC meeting	5 - 6 February, 2017	18 th Research Advisory Committee Meeting of ICAR - NRCB
Swachh Bharath	2 October, 2016	Swachh Bharath awareness rally was held at ICAR - NRCB
Rastriya Ekta Divas	31 October, 2016	Staff of ICAR - NRCB took a pledge for National unity
Vigilance Awareness Week	31 October to 5 November, 2016	Staff of ICAR - NRCB took a pledge
Communal Harmony Campaign	19 to 25 November, 2016	Various competitions for school children were conducted and prizes were distributed
Constitution Day	26 November, 2016	Preamble of the constitution was recited
World Soil Day	5 December, 2016	Distribution of soil health cards to farmers by Director
Agriculture Education Day	9 December, 2016	Various competitions for school children were conducted and prizes were distributed
National Science Day	28 February, 2017	Various competitions for specially abled school children were conducted and prizes were distributed
International Women's Day from Celebrations	8 March, 2017	Cultural events were performed by women college students HC & RIW, Tiruchirapalli, TNAU

PROMOTION

Name	Event	Date
Dr. P. Suresh Kumar, Senior Scientist	Promoted to Senior Scientist (RGP Rs. 9000/-)	w.e.f. 25 June, 2015
Mr. P. Ravichamy, Technical Officer	Promoted to Senior Technical Officer	w.e.f. 1 May, 2015
Ms. T. Anitha Sree, Technical Officer	Promoted to Senior Technical Officer	w.e.f. 1 May, 2015
Mr. M. Badrinath, Technical Assistant	Promoted to Senior Technical Assistant	w.e.f. 4 October, 2015
Mr. P. Mohan, Technical Assistant	Promoted to Senior Technical Assistant	w.e.f. 8 July, 2016

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